Mariner Mars 1971 Mission Support

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This article completes and updates the description of the planned DSN configuration for support of Mariner 9 orbit insertion and orbit operations. Specifically covered are the S-band occultation experiment data handling, planetary ranging configuration, and the simulation configuration.

I. Introduction

Previous articles in this series described the configuration of the six DSN Systems for support of the *Mariner* Mars 1971 mission. Because of their unique nature and because of changes since their original description, several capabilities applicable to support of the Mars orbital mission need to be described to make this series of articles complete. These capabilities are:

(1) Occultation data handling.

(2) Planetary ranging configuration.

(3) Final simulation configuration.

II. Occultation Data Handling

The occultation experimenter is interested in two types of data: open-loop data and closed-loop data. The configuration for providing these data to the experimenter is shown in Fig. 1. The on-site instrumentation for acquisition of the open-loop data is described in Ref. 1. The instrumentation at CTA 21 for digitization of the analog tapes is described in Ref. 2. The TDH punched paper tape in excess of that transmittable to the SFOF in real time will be allowed to back up at DSSs 12, 41, and 62 and to catch up during the remainder of the pass, or immediately after pass if necessary.

The occultation experimenter originally required the open-loop data from DSS 14 within 6 hours of the occultation. Negotiations have since extended this time to noon of the following day, about 15 hours, on only six days of the week. This enables use of the daily flights to Goldstone and the scheduling of only one special flight per weekend. The experimenter plans to accomplish two day's processing on each Monday.

III. Planetary Ranging Configuration

A set of circumstances, some of them differing from the original plan, have caused a modification in the

strategy for provision of a planetary ranging capability for *Mariner* Mars 1971. The circumstances are:

(1) Tau ranging threshold[1] at DSS 14, *with* command modulation:

	20 kW	*100–400 kW*
Nominal:	Mar. 12, 1972	No significant extension
Worst case:	Feb. 14, 1972	

(2) Tau ranging threshold (Footnote 1) at DSS 14, *without* command modulation:

	20 kW	*100 kW*	*400 kW and LGA*
Nominal:	Mar. 17, 1972	Mar. 21, 1972	No significant extension after March 21
Worst case:	Feb. 23, 1972	Mar. 9, 1972	

(3) Mu ranging threshold (Footnote 1) at DSS 12, *with* command modulation:

Nominal: Dec. 9, 1971 (10-kW transmitter)

(4) Mu ranging threshold (Footnote 1) at DSS 12, *without* command modulation:

Nominal: Late Feb. 1972 (10-kW transmitter)

Worst case: Early Feb. 1972 (10-kW transmitter)

(5) Mu ranging threshold (Footnote 1) at DSS 14:

Nominal: Threshold not exceeded at 20 kW

(6) As a result of the loss of *Mariner 8*, two, rather than three, TCP 920 computers will be available at DSS 14, and two at DSS 12. Mu ranging requires the use of one TCP 920 computer. Until the DSIF tracking subsystem (DTS) is available, Tau ranging requires the use of one TCP 920 computer.

(7) The DTS–Tau ranging capability will be delivered too late for use at the start of orbit operations.

Considering these circumstances, the following was concluded:

(1) For the first part of the orbital mission, a 920 computer must be used for range data processing.

(2) Between DSSs 12 and 14 there are four TCP 920 computers, one is required for high-rate telemetry, one for low-rate telemetry and command, and a third for range data processing until the DTS is available. It seems reasonable to provide the most readily available backup, the fourth 920, to the high-rate telemetry function. In most cases range data processing can be sacrificed if its computer fails. Short delays can be tolerated in low-rate telemetry/command processing.

(3) Considering the various thresholds, it appears that the Extended Mission planetary ranging requirement can only be satisfied by the Mu system located at DSS 14.

(4) When the time is reached that all necessary processing can be performed at DSS 14, there is no justification to also use DSS 12 for *Mariner* Mars 1971 support.

Therefore, the following plan has been adopted:

(1) During the pre-orbit insertion period, when no high-rate telemetry is involved:

(a) During regularly scheduled DSS 14 tracks, use Tau ranging with TCP 920 range data processing. The other TCP 920 will be used to support low-rate telemetry and command. DSS 12 will not be scheduled. Sacrifice ranging if only one 920 is available.

(b) During regularly scheduled DSS 12 tracks, use Mu ranging with TCP 920 range data processing. The second TCP 920 will be used to support low-rate telemetry and command. DSS 14 will not be scheduled. Sacrifice ranging if only one 920 is available.

(2) Pre-orbital science through approximately mid-December and also prior to pre-orbital science activity when high-rate telemetry is involved:

(a) Both DSSs 12 and 14 will be scheduled. Use Mu ranging at DSS 12 with TCP 920 range data processing and with second TCP 920 used for command and low-rate telemetry. DSS 14 used for high-rate telemetry processing only, with second 920 in a backup role. If only one TCP is available at DSS 12, Project has option of sacrificing ranging or using Tau ranging at DSS 14 without high-rate telemetry backup or command capability.

(b) Off-spacecraft checkout of Tau/DTS will be accomplished during this period.

[1]Assumes high power, best high-gain antenna position, 180-min maximum acquisition, high-rate telemetry, 25-deg elevation, 9-dB (Tau) or 3-dB (Mu) range suppression.

(3) Mid-December through end of nominal mission: Use Tau–DTS ranging, with one TCP 920 on high-rate telemetry, second on low-rate telemetry/command. DSS 12 on one hour or less callup to cover DSS 14 920 failures.

(4) Extended Mission: Shift Mu ranging system to DSS 14 and use.

IV. Simulation System Configuration

Reference 3 provided a thorough description of the Simulation System for support of *Mariner* Mars 1971 and should be reviewed to understand this discussion. The Simulation Center design has not met expectations since it was implemented. The major problems have been:

(1) 6050 computer reliability. There is only one 6050, and when it fails, the flow of simulated data stops.

(2) 1108 response failures. When the 6050 needs data to feed the data lines, it asks the 1108 computer, which must respond within a fixed period of time; if it does not, everything comes to an abrupt halt.

Nothing much could be done about the first problem. However, the second problem led to much experimentation with the mode of operation in the 6050 and 1108; the actual configuration as described in Ref. 3 remained the same.

Initial efforts were aimed at running the simulation mathematical model in the same 1108 as the navigation software, with the aim of eliminating the response failures by placing controls on the level of input/output activity of the navigation programs. This obviously could not be done with simulation co-existing with all other general-purpose computing in the second 1108. The result of this experiment was the slowing down of the navigation programs to an unacceptable level.

The second approach was to limit the amount of other activity on the second 1108 by limiting the number of communications ports and to raise the priority of simulation activity through various system program modifications. None of these attempts worked—the response failures continued.

Finally, for the last three days of need for simulated data, all stops were pulled. Navigation was run on 1108B and simulation on 1108A, all by itself. It worked. Unfortunately, the cost to the DSN of this type of operation is overwhelming. In addition, this precluded the availability of the 1108 to the other users.

References

1. Laeser, R. P., "*Mariner* Mars 1971 Mission," in *The Deep Space Network*, Space Programs Summary 37-63, Vol. II, pp. 11–14. Jet Propulsion Laboratory, Pasadena, Calif., May 31, 1970.

2. Laeser, R. P., "*Mariner* Mars 1971 Mission Support," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. I, pp. 4–6. Jet Propulsion Laboratory, Pasadena, Calif., Feb. 15, 1971.

3. Laeser, R. P., "*Mariner* Mars 1971 Mission Support," in *The Deep Space Network*, Space Programs Summary 37-61, Vol. II, pp. 18–22. Jet Propulsion Laboratory, Pasadena, Calif., Jan. 31, 1970.

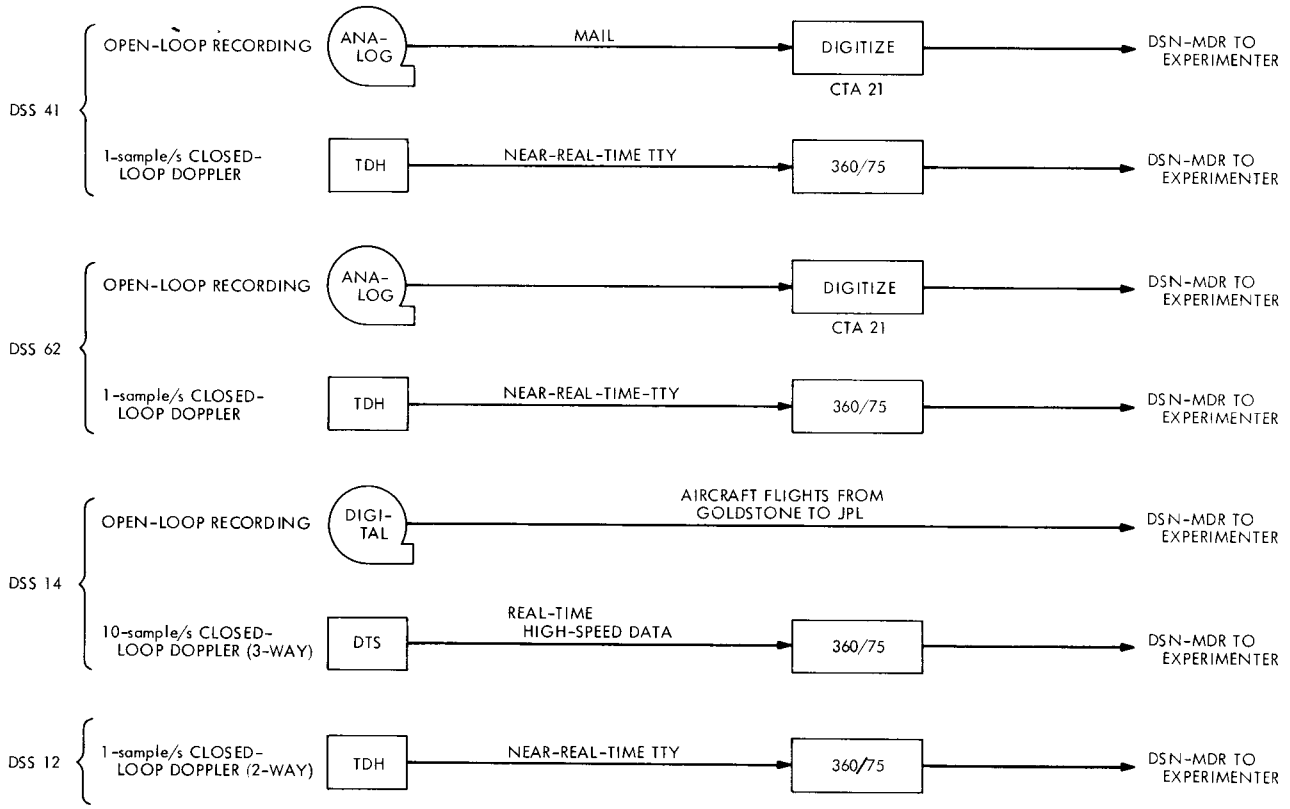

Fig. 1. DSN/*Mariner* Mars 1971 occultation configuration